

6. Analysis of Benefits and Costs

An analysis of benefits and costs is a systematic approach for comparing alternative ways to satisfy an objective. The analysis of benefits and costs provides a structured framework for collecting, analyzing, displaying, and communicating pertinent information to the decision making process. The analysis of benefits and costs process includes the following steps:

- Identify technically and operationally feasible alternatives for satisfying stated objectives
- Identify the benefits and costs of each alternative over the project lifecycle
- Determine when benefits and costs occur
- Compare the alternatives

Benefits result from improved operations or decreased operating costs. Benefits can also result from an increase in capabilities or services available to the organization or the organization's customers. Dollar values are assigned to benefits that are either one-time (non-recurring) or occur over the life of the project (recurring).

Costs are the value of input used or expended in developing, acquiring, or operating a resource. Costs that are incurred throughout the life of a project are identified and estimated. Non-recurring costs are the one-time expenses, such as tailoring of facilities, purchase of equipment, and development of courseware. Recurring costs are expenses that occur on a regular basis throughout the life of the project, such as equipment maintenance, studio time, instructor costs, and transmission costs. Sunk costs are already expended and are not included in the analysis of benefits and costs. For this analysis, dollars expended in fiscal year 1997 are considered sunk costs.

6.1 Methodology Used for Business Case

The methodology described in the Department of Energy's *Analysis of Benefits and Costs (ABC's) Guideline* was used to perform the analysis of benefits and costs on the five technology-supported learning alternatives. This methodology is similar to the discounted cashflow (DCF) technique widely used in the private and public sector. Both methodologies are tools that help decision makers make go/no-go decisions when considering investment opportunities and ranking investments when more than one alternative is available.

The Department's *Analysis of Benefits and Costs (ABC's) Guideline* is based on the understanding that a dollar today is worth more than a dollar a year from now. Two principles were derived from this understanding of a dollar's value.

- Benefits accruing in the future are worth less than the same level of benefits that accrue now.
- Costs that occur in the future are less burdensome than costs that occur now.

To perform this analysis, the benefits and costs that will be derived from investment decisions were identified and quantified. All future cash flows (both positive and negative) were discounted based on the timing of the cash flow and on the discount rate for the entire investment. The discounted cash flows were added together to determine the overall Net Present Value (NPV) of the investment alternative. To determine if an investment should be made, the NPV of the investment should be positive when only one investment is considered, or identify the investment with the highest NPV when more than one alternative is available. Detailed worksheets showing the computational data that was used for the analysis of benefits and costs are available for inspection upon request.

For this analysis of benefits and costs, “real” dollars and discount rates were used rather than “nominal” dollars and rates. Real dollars or “constant” dollars are dollars having the same purchasing power based on a time reference period called the baseline year (in this case fiscal year 1997). This approach explicitly excludes the impact of inflation on both the dollar values and the discount rate. With future amounts expressed in real dollars, it is necessary to adjust the amounts for the opportunity cost of money (i.e., the additional factor that changes the value of money over time). This time adjustment can be accomplished by applying appropriate discount formulas to the future amounts. For this analysis, the Office of Management and Budget (OMB) “real” discount rate of 3.1 percent was used.

Once the benefits and costs were identified, the Net Present Value was used to evaluate each alternative. In this business case, Return on Investment is used synonymously with Net Present Value. Table 6-1 provides a summary of the Net Present Value and payback year for each alternative.

Net Present Value (NPV). NPV is calculated by subtracting the total present value cost from the total present value benefit of the alternative. The NPV is expressed in millions of dollars. The higher an alternative's positive NPV, the more its benefits exceed its costs. From an economic analysis point of view, the alternative with the highest NPV is frequently the most desirable.

There are times when the highest NPV is not the best choice. *Volume 1, A Manager's Guide to Analysis of Benefits and Costs of DOE's Analysis of Benefits and Costs (ABC) Guideline*, states: “Mitigating factors, such as different non-quantifiable benefits among the alternatives, large initial cash outlays, budgetary constraints, manpower restrictions, and other factors may require selection of an alternative that does not have the highest NPV.”

Benefit/Cost Ratio (BCR). DOE's *Analysis of Benefits and Costs (ABC's) Guideline* states that the “benefit/cost ratio (BCR) is the present value of benefits divided by the present value of costs.” The BCR provides a measure of the benefits obtained per dollar spent and is expressed as a decimal number. The BCR is a relative measure of an alternative's value.

Payback Year. Plotting the NPV by year shows where the benefits equal the costs of each alternative, typically called the break-even point. The length of time required to reach the break-even point is called the payback period. The payback year is the year in which the total benefits begin to exceed the total costs for the alternative.

Table 6-1. Summary of Analysis Results

Alternative	Net Present Value or Return On Investment	Benefit/ Cost Ratio	Payback Year
A - Focus on Interactive Television	\$60,302,037	2.89	1999
B - Focus on Multimedia	\$65,420,479	3.03	1999
C - Focus on High-Speed Networks	\$65,349,623	3.02	1999
D - Multi-Technology Solution	\$66,902,297	3.12	1999
E - Non-Corporate Approach	\$ 2,096,051	1.22	2001

6.2 Spreadsheet Model Development

The spreadsheet model used for each alternative consists of a series of inputs to calculate the quantifiable costs and benefits associated with each alternative. The following spreadsheets were used in this model.

Assumptions: This worksheet contains on set of general assumptions relating to salaries, technology acquisition costs, travel costs, etc. that were used to analyze and compare all alternatives (table G-1 in appendix G). The assumptions were based on actual Departmental experience when relevant data was available for analysis. Appendix G contains the assumptions and their definitions.

Alternative Characterization: This worksheet contains information on course conversion, technology acquisition, and partnering plans for the specific alternative being considered. Each alternative has its own Alternative Characterization worksheet.

Usage Estimates: This worksheet contains summary information, such as the number of courses offered, average course enrollment, and course length for each alternative. Each alternative has its own Usage Estimates worksheet.

Summary: This worksheet contains the summary of the analysis of benefits and costs that are calculated in the Quantifiable Benefits and Costs worksheets described below. The Summary worksheet also calculates the net present value for each alternative. Each alternative has its own Summary worksheet.

Quantifiable Benefits and Costs (for ITV, MM/CBT, Internet): These worksheets contain the detailed calculations that were used to quantify the benefits and costs of each alternative. These benefits and costs are based on inputs from the Assumptions, Alternative Characterization, and Usage Estimates worksheets and were automatically transferred to the Summary worksheet. The detailed worksheets showing the computational data that was used are available upon request.

Sections 6-4 and 6-5 provide summaries of the analysis of benefits and costs performed for the Multi-Technology Solution (alternative D) and the Non-Corporate Approach (alternative E). A summary of the analysis of benefits and costs for alternatives A, B, and C is provided in appendix G.

Note: Some language inconsistencies occur in the spreadsheets. These inconsistencies do not affect the results of the analysis or the business case recommendations.

6.3 Results of the Analysis of Benefits and Costs

Results of the analysis of benefits and costs indicate that alternatives A through D, which focus on a corporate approach to interactive television, multimedia, and Internet delivery methods, are significantly more cost-effective than the non-corporate approach to technology-supported learning (alternative E). For the 5-year period included in the analysis, alternatives A, B, C, and D each generate a return on investment of at least \$65 million. The non-corporate approach for the same period generates a return on investment of approximately \$2 million.

It should be noted that the return on investment associated with each alternative assumes that once a cross-cutting learning activity is delivered via technology-supported learning, any duplicate learning activities delivered via traditional methods would no longer be available to, or used by, employees with access to that technology-supported learning activity.

6.4 Multi-Technology Solution (Alternative D)

As described in section 5.4, alternative D is the multi-technology solution to technology-supported learning and represents a synthesis of alternatives A through C. This alternative calls for installing digital satellite downlink facilities at 5 sites in fiscal year 1997 and at 23 sites in fiscal year 1998.

Alternative D also calls for establishing a total of 150 MM/CBT learning centers with at least 6 multimedia workstations at each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000, and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

A total of 150 courses would be converted to a technology-supported learning medium with 45 to ITV, 83 to MM/CBT, and 22 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value, return on investment, and benefit/cost ratio are provided in table 6-2. Figure 6-1 graphically depicts the individual and cumulative cash flows for this alternative. Table 6-3 provides the alternative D characterization, table 6-4 provides alternative D usage estimates, and table 6-5 provides a summary of the analysis data for alternative D.

Table 6-2. Summary of Alternative D Benefits and Costs

		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Total Benefits		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Non-recurring Costs		\$ -	\$ (4,989,315)	\$ (3,357,523)	\$ (3,410,285)	\$ (3,068,923)	\$ (3,068,923)
Recurring Costs		\$ -	\$ (1,541,683)	\$ (2,781,849)	\$ (3,881,936)	\$ (4,528,889)	\$ (5,160,895)
Total Costs		\$ -	\$ (6,530,998)	\$ (6,139,372)	\$ (7,292,220)	\$ (7,597,812)	\$ (8,229,818)
Return on Investment		\$ -	\$ (2,659,043)	\$ 6,185,091	\$ 14,750,918	\$ 24,783,550	\$ 35,345,926
			3.1%				
Return on Investment (Net Present Value)		\$ 66,902,297					
Payback Year		FY 99					
Benefit/ Cost Ratio		3.12					
Total Capital Invested		\$ 9,184,487					

Figure 6-1. Alternative D Cash Flows

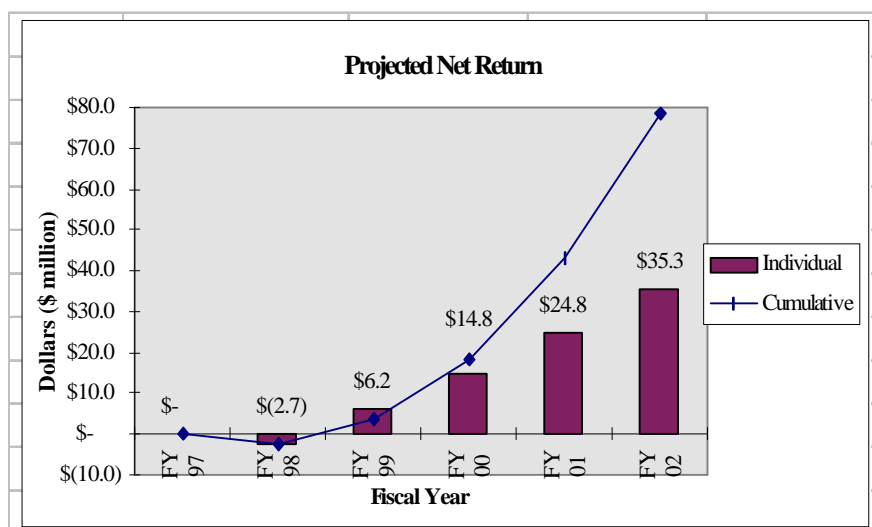


Table 6-3. Alternative D Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
<i>Courses Converted</i>						
ITV		9	9	9	9	9
Multi-Media / CBT		14	15	16	19	19
Internet		1	4	5	6	6
Total Courses Converted		0	24	28	30	34
<i>Cumulative Courses Converted</i>						
ITV		0	9	18	27	36
Multi-Media / CBT		0	14	29	45	64
Internet		0	1	5	10	16
Total Courses Converted		0	24	52	82	116
<i>Technology Acquisition</i>						
Satellite Uplink Facilities		1	0	0	0	0
Satellite Downlink Facilities		5	23	0	0	0
Classroom Conversion to ITV			23	0	0	0
Classroom conversion to training center			75	40	35	0
Number of Computers per training center			6	6	6	6
ITV Production Studios			0	0	0	0
MM / CBT computers (in training centers)			450	240	210	0
MM / CBT computers (stand alone Internet)			0	0	0	0
Servers needed to support Internet			0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities		0	0	0	0	0
Satellite Downlink Facilities			23	23	23	23
Classroom Conversion to ITV			23	23	23	23
Training Centers			75	115	150	150
Production Studios			0	0	0	0
Multi-media computer platforms			0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)		10%	10%	10%	10%	20%
Partnering (5 way - 20%)		10%	10%	10%	10%	20%
DOE Developed (100%)		80%	80%	80%	80%	60%
Discount Multiplier		87%	87%	87%	87%	74%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)		10%	10%	10%	10%	10%
Purchased [67% of full cost] (% of total converted)		20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)		50%	50%	50%	50%	50%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost]	(Courses)	-	2.0	3.0	3.0	3.0
Partnering [33% of full cost]	(Courses)	-	1.0	1.0	1.0	1.0
Purchased [67% of full cost]	(Courses)	-	2.0	3.0	3.0	3.0
Internally Developed [full cost]	(Courses)	-	9.0	8.0	9.0	12.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)		5%	5%	5%	5%	10%
Partnering (3 way - 33%)		5%	5%	5%	5%	10%
DOE Developed (100%)		90%	90%	90%	90%	80%
Discount Multiplier		92%	92%	92%	92%	83%
<i>ITV Quality (% of courses of each type)</i>						
High Quality (\$15,000 / hour)		50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)		50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV		20%	20%	20%	20%	20%
MM / CBT		20%	20%	20%	20%	20%
Internet		20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV		1,835	1,835	1,835	1,835	1,835
MM / CBT		2,560	2,560	2,560	2,560	2,560
Internet		1,764	1,764	1,764	1,764	1,764
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)		100%	100%	100%	100%	100%
Conversion Cost						
MM / CBT Conversion Learning Curve		100%	100%	100%	100%	100%
Elimination of Redundant MM / CBT Course Devlp.		100%	100%	100%	100%	100%
MM / CBT Conversion Cost Multiplier		100%	100%	100%	100%	100%
MM / CBT Incompatibility		100%	100%	100%	100%	100%

Table 6-4. Alternative D Usage Estimates

		FY	FY	FY	FY	FY	FY
<i>USAGE ESTIMATES</i>		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	43	43	43	43
Number of courses offered using ITV			4	13	22	31	40
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1835	1835	1835	1835	1835	1835
Course Compression time (% of lecture time)			65%	65%	65%	65%	65%
Pre-Converted Course Length	(hours)		9.23	9.23	9.23	9.23	9.23
Classroom Instructor Prep Time	hours / course hour		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			4	13	22	31	40
Total Number of Classes (# courses times # sites)			80	559	946	1,333	1,720
Total Number of Students			7,340	23,855	40,370	56,885	73,400
Total Hours of Instruction			44,040	143,130	242,220	341,310	440,400
Students who avoid travel with ITV			147	477	807	1,138	1,468
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	7	21	37	54	73
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		2,560	2,560	2,560	2,560	2,560	2,560
Total Number of Students Instructed		-	17,920	53,760	94,720	138,240	186,880
Students who avoid travel with MMCBT			358	1,075	1,894	2,765	3,738
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	0.5	3	7.5	13	19
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,764	1,764	1,764	1,764	1,764	1,764
Total Number of Students		-	882	5,292	13,230	22,932	33,516
Total Hours of Instruction			5,292	31,752	79,380	137,592	201,096
Students who avoid travel with Internet training			18	106	265	459	670

Table 6-5. Summary of Alternative D Analysis Data

		FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
SUMMARY							
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
<i>ITV</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 322,960	\$ 1,049,620	\$ 1,776,280	\$ 2,502,940	\$ 3,229,600
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 41,104	\$ 133,588	\$ 226,072	\$ 318,556	\$ 411,040
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 24,080	\$ 78,260	\$ 132,440	\$ 186,620
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 1,264	\$ 8,832	\$ 14,947	\$ 21,061	\$ 27,176
Course Compression	(\$ / year)	\$ -	\$ 829,985	\$ 2,697,450	\$ 4,564,915	\$ 6,432,381	\$ 8,299,846
	Sub-total	\$ -	\$ 1,195,313	\$ 3,913,570	\$ 6,660,474	\$ 9,407,378	\$ 12,154,282
<i>MULTI-MEDIA / CBT</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 394,240	\$ 1,182,720	\$ 2,083,840	\$ 3,041,280	\$ 4,111,360
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 50,176	\$ 150,528	\$ 265,216	\$ 387,072	\$ 523,264
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 73,500	\$ 220,500	\$ 388,500	\$ 567,000	\$ 766,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 5,530	\$ 16,590	\$ 29,230	\$ 42,660	\$ 57,670
Course Compression	(\$ / year)	\$ -	\$ 2,026,338	\$ 6,079,015	\$ 10,710,646	\$ 15,631,754	\$ 21,131,815
	Sub-total	\$ -	\$ 2,549,784	\$ 7,649,353	\$ 13,477,432	\$ 19,669,766	\$ 26,590,609
<i>INTERNET</i>							
Reduction in Student Air Travel Costs	(\$ / year)	\$ -	\$ 19,404	\$ 116,424	\$ 291,060	\$ 504,504	\$ 737,352
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 2,470	\$ 14,818	\$ 37,044	\$ 64,210	\$ 93,845
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 5,250	\$ 31,500	\$ 78,750	\$ 136,500	\$ 199,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ 395	\$ 2,370	\$ 5,925	\$ 10,270
Course Compression	(\$ / year)	\$ -	\$ 99,734	\$ 598,403	\$ 1,496,008	\$ 2,593,080	\$ 3,789,886
	Sub-total	\$ -	\$ 126,857	\$ 761,540	\$ 1,905,232	\$ 3,304,219	\$ 4,830,853
Total Recurring Benefit		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Non-Recurring Costs							
<i>ITV</i>							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 460,000	\$ -	\$ -	\$ -	\$ -
Classroom Conversion	(\$ / year)	\$ -	\$ 345,000	\$ -	\$ -	\$ -	\$ -
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 686,631	\$ 686,631	\$ 686,631	\$ 584,031	\$ 584,031
	Sub-total	\$ -	\$ 1,491,631	\$ 686,631	\$ 686,631	\$ 584,031	\$ 584,031
<i>MULTI-MEDIA / CBT</i>							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 1,950,000	\$ 1,040,000	\$ 910,000	\$ -	\$ -
Course Distribution	(\$ / year)	\$ -	\$ 28,000	\$ 30,000	\$ 32,000	\$ 38,000	\$ 38,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 1,477,385	\$ 1,431,692	\$ 1,570,154	\$ 1,985,538	\$ 1,985,538
	Sub-total	\$ -	\$ 3,455,385	\$ 2,501,692	\$ 2,512,154	\$ 2,023,538	\$ 2,023,538

Table 6-5. Summary of Alternative D Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ 42,300	\$ 169,200	\$ 211,500	\$ 461,354	\$ 461,354
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ 42,300	\$ 169,200	\$ 211,500	\$ 461,354	\$ 461,354
Total Non-Recurring Costs		\$ -	\$ 4,989,315	\$ 3,357,523	\$ 3,410,285	\$ 3,068,923	\$ 3,068,923
Recurring Costs							
ITV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 58,464	\$ 190,008	\$ 321,552	\$ 453,096	\$ 584,640
Instructor Preparation	(\$ / year)	\$ -	\$ 10,962	\$ 35,627	\$ 60,291	\$ 72,261	\$ 93,240
Course Update	(\$ / year)	\$ -	\$ 3,341	\$ 10,858	\$ 18,374	\$ 22,022	\$ 28,416
Satellite Air Time	(\$ / year)	\$ -	\$ 8,394	\$ 27,280	\$ 46,166	\$ 55,331	\$ 71,395
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Facilitator Cost	(\$ / year)	\$ -	\$ 67,200	\$ 469,560	\$ 794,640	\$ 1,119,720	\$ 1,444,800
Downlink service charge	(\$ / year)	\$ -	\$ 211,968	\$ 211,968	\$ 211,968	\$ 211,968	\$ 211,968
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 2,304	\$ 16,099	\$ 27,245	\$ 38,390	\$ 49,536
	Sub-total	\$ -	\$ 362,633	\$ 961,399	\$ 1,480,236	\$ 1,972,789	\$ 2,483,995
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 25,200	\$ 75,600	\$ 133,200	\$ 194,400	\$ 262,800
Training Center computer maintenance	(\$ / year)	\$ -	\$ 26,250	\$ 40,250	\$ 52,500	\$ 52,500	\$ 52,500
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 1,050,000	\$ 1,610,000	\$ 2,100,000	\$ 2,100,000	\$ 2,100,000
Course Re-distribution	(\$ / year)	\$ -	\$ 7,000	\$ 21,000	\$ 37,000	\$ 108,000	\$ 146,000
	Sub-total	\$ -	\$ 1,178,450	\$ 1,816,850	\$ 2,392,700	\$ 2,524,900	\$ 2,631,300
INTERNET							
Course Update	(\$ / year)	\$ -	\$ 600	\$ 3,600	\$ 9,000	\$ 31,200	\$ 45,600
	Sub-total	\$ -	\$ 600	\$ 3,600	\$ 9,000	\$ 31,200	\$ 45,600
Total Recurring Costs		\$ -	\$ 1,541,683	\$ 2,781,849	\$ 3,881,936	\$ 4,528,889	\$ 5,160,895
		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
ANALYSIS OF BENEFITS AND COSTS							
Reduction in Operating Costs		\$ -	\$ 3,871,955	\$ 12,324,463	\$ 22,043,138	\$ 32,381,363	\$ 43,575,744
Capital Investment		\$ -	\$ (3,169,664)	\$ (1,760,066)	\$ (1,769,485)	\$ (1,212,077)	\$ (1,273,195)
Operating Expenses		\$ -	\$ (3,361,334)	\$ (4,379,306)	\$ (5,522,735)	\$ (6,385,736)	\$ (6,956,623)
Return on Investment		\$ -	\$ (2,659,043)	\$ 6,185,091	\$ 14,750,918	\$ 24,783,550	\$ 35,345,926

6.5 Non-Corporate Approach (Alternative E)

As described in section 5.5, alternative E is the non-corporate approach to education and training and represents the projected state of technology-supported learning within the Department if a corporate approach is not taken.

This alternative calls for installing digital satellite downlink facilities at five sites in fiscal year 1997 and at four sites each year for fiscal years 1998, 1999, 2000, 2001 and 2002.

Alternative E also calls for establishing a total of 45 MM/CBT learning centers with at least 6 multimedia workstations at each center. The learning centers would be distributed throughout the DOE complex.

It is assumed that local area networks will be upgraded to enable 100 percent connectivity to the Internet by fiscal year 2000, and that this connectivity will be achieved through other DOE-wide or organizational level telecommunications enhancements.

It was estimated that a total of 41 courses would be converted to a technology-supported learning delivery method with 19 to ITV, 10 to MM/CBT, and 12 to an Internet format.

A summary of the recurring and non-recurring benefits and costs and the net present value and benefit/cost ratio are provided in table 6-6. Figure 6-2 graphically depicts the individual and cumulative cash flows for this alternative. Table 6-7 provides the alternative E characterization, table 6-8 provides alternative E usage estimates, and table 6-9 provides a summary of the analysis data for alternative E.

Table 6-6. Summary of Alternative E Benefits and Costs

ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-recurring Costs		\$ -	\$ (1,066,085)	\$ (1,128,785)	\$ (1,128,785)	\$ (1,257,426)	\$ (1,257,426)
Recurring Costs		\$ -	\$ (282,000)	\$ (637,735)	\$ (1,021,272)	\$ (1,428,596)	\$ (1,868,192)
Net Result		\$ -	\$ (903,910)	\$ (222,303)	\$ 508,378	\$ 1,175,939	\$ 2,029,571
OMB Discount Rate		3.1%					
Net Present Value		\$ 2,096,051					
Return on Investment		46%					
Benefit/ Cost Ratio		1.22					

Figure 6-2. Alternative E Cash Flows

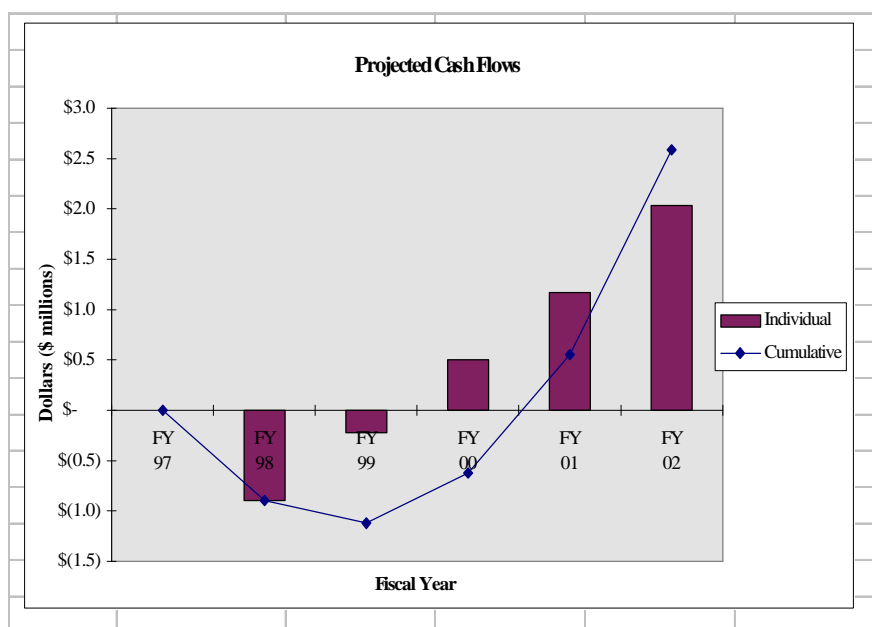


Table 6-7. Alternative E Characterization
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	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02
Alternative Characterization						
<i>Courses Converted</i>						
ITV		3	4	4	4	4
Multi-Media / CBT		2	2	2	2	2
Internet		2	2	2	3	3
Total Courses Converted	0	7	8	8	9	9
<i>Cumulative Courses Converted</i>						
ITV	0	3	7	11	15	19
Multi-Media / CBT	0	2	4	6	8	10
Internet	0	2	4	6	9	12
Total Courses Converted	0	7	15	23	32	41
<i>Technology Acquisition</i>						
Satellite Uplink Facilities	1	0	0	0	0	0
Satellite Downlink Facilities	5	4	4	4	4	4
Classroom Conversion to ITV		4	4	4	4	4
Classroom conversion to training center		9	9	9	9	9
Number of Computers per training center		6	6	6	6	6
ITV Production Studios		0	0	0	0	0
MM / CBT computers (in training centers)		54	54	54	54	54
MM / CBT computers (stand alone Internet)		0	0	0	0	0
Servers needed to support Internet		0	0	0	0	0
<i>Technology Acquisition (Cumulative)</i>						
Satellite Uplink Facilities		0	0	0	0	0
Satellite Downlink Facilities		4	8	12	16	20
Classroom Conversion to ITV		4	8	12	16	20
Training Centers		9	18	27	36	45
Production Studios		0	0	0	0	0
Multi-media computer platforms		0	0	0	0	0
<i>Partnerships for ITV Course Development (approximate percent of total)</i>						
Partnering (2 way - 50%)	5%	5%	5%	5%	10%	10%
Partnering (5 way - 20%)	5%	5%	5%	5%	10%	10%
DOE Developed (100%)	90%	90%	90%	90%	80%	80%
Discount Multiplier	94%	94%	94%	94%	87%	87%
<i>Partnerships for MM Course Development (approximate percent of total)</i>						
Obtained Free [0% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Partnering [33% of full cost] (% of total converted)	0%	0%	0%	0%	0%	0%
Purchased [67% of full cost] (% of total converted)	20%	20%	20%	20%	20%	20%
Internally Developed [full cost] (% of total converted)	60%	60%	60%	60%	60%	60%
<i>Partnerships for MM Course Development (by course)</i>						
Obtained Free [0% of full cost] (Courses)	-	-	-	-	-	-
Partnering [33% of full cost] (Courses)	-	-	-	-	-	-
Purchased [67% of full cost] (Courses)	-	-	-	-	-	-
Internally Developed [full cost] (Courses)	-	2.0	2.0	2.0	2.0	2.0
<i>Partnerships for Internet Course Development (approximate percent of total)</i>						
Free (0%)	5%	5%	5%	5%	10%	10%
Partnering (3 way - 33%)	5%	5%	5%	5%	10%	10%
DOE Developed (100%)	90%	90%	90%	90%	80%	80%
Discount Multiplier	92%	92%	92%	92%	83%	83%
<i>ITV Quality (% of courses of each type)</i>						
CTA Level (\$15,000 / hour)	50%	50%	50%	50%	50%	50%
Junior College Type (\$4,000 / hour)	50%	50%	50%	50%	50%	50%
<i>Percent of Courses Updated (yearly)</i>						
ITV	20%	20%	20%	20%	20%	20%
MM / CBT	20%	20%	20%	20%	20%	20%
Internet	20%	20%	20%	20%	20%	20%
<i>Average Class Enrollment Assumptions</i>						
ITV	1,835	1,835	1,835	1,835	1,835	1,835
MM / CBT	2,561	2,561	2,561	2,561	2,561	2,561
Internet	1,765	1,765	1,765	1,765	1,765	1,765
<i>Corporate/ Non-corporate approach Multipliers</i>						
Enrollment (due to advertisement)	65%	65%	65%	65%	65%	65%
Conversion Cost						
MM / CBT Conversion Learning Curve	125%	125%	125%	125%	125%	125%
Elimination of Redundant MM / CBT Course Devlp.	120%	120%	120%	120%	120%	120%
MM / CBT Conversion Cost Multiplier	150%	150%	150%	150%	150%	150%
MM / CBT Incompatibility	70%	70%	70%	70%	70%	70%

Table 6-8. Alternative E Usage Estimates

		FY	FY	FY	FY	FY	FY
USAGE ESTIMATES		97	98	99	00	01	02
<i>ITV Training</i>							
Number of Organizations using ITV			20	24	28	32	36
Number of courses offered using ITV			1	5	9	13	17
Average Length of Course (post converted hours)		6	6	6	6	6	6
Number of Students per course using ITV		1192	1192	1192	1192	1192	1192
Course Compression time (% of lecture time)			85%	85%	85%	85%	85%
Pre-Converted Course Length	(hours)		7.06	7.06	7.06	7.06	7.06
Classroom Instructor Prep Time	hours / course hour		4	4	4	4	4
ITV Prep Ratio (hr Prep per hr. class)			5	5	5	5	5
Percent of Classes needing a Facilitator			50%	50%	50%	50%	50%
Facilitator Time required per class(hours / class)			16	16	16	16	16
Total Number of Courses delivered			1	5	9	13	17
Total Number of Classes (# courses times # sites)			20	120	252	416	612
Total Number of Students			1,192	5,960	10,728	15,496	20,264
Total Hours of Instruction			7,152	35,760	64,368	92,976	121,584
Students who avoid travel with ITV			24	119	215	310	405
<i>Multi-Media / Computer Based Training</i>							
Number of organizations using multi-media courses			50	50	50	50	50
Number of courses offered using MM / CBT		0	1	3	5	7	9
Average Length of Course (hours)		6	6	6	6	6	6
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length		9.2	9.2	9.2	9.2	9.2	9.2
Percent of Courses "Refreshed" each year		20%	20%	20%	20%	20%	20%
Centralized Help Line Support (FTEs per year)			1	1	1	1	1
Proctors / Training Center (FTEs / center)			0.20	0.20	0.20	0.20	0.20
Average Number of Students per course		1,165	1,165	1,165	1,165	1,165	1,165
Total Number of Students Instructed		-	1,165	3,495	5,825	8,155	10,485
Students who avoid travel with MMCBT			23	70	117	163	210
<i>Internet Training</i>							
Number of organizations using Internet			50	50	50	50	50
Number of courses offered using Internet		0	1	3	5	7.5	10.5
Average Length of Course (hours)		6	6	6	6	6	6
Number of Times Course is Delivered		3	3	3	3	3	3
Course Compression time (% of lecture time)		65%	65%	65%	65%	65%	65%
Pre-converted course length	(hours)	9.2	9.2	9.2	9.2	9.2	9.2
Average Number of Students per course		1,147	1,147	1,147	1,147	1,147	1,147
Total Number of Students		-	1,147	3,441	5,735	8,603	12,044
Total Hours of Instruction			6,882	20,646	34,410	51,615	72,261
Students who avoid travel with Internet training			23	69	115	172	241

Table 6-9. Summary of Alternative E Analysis Data

		FY	FY	FY	FY	FY	FY
SUMMARY		97	98	99	00	01	02
Non-recurring Benefits							
No "Non-recurring Benefits" identified							
Total Non-recurring Benefit		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits							
ITV							
Air Travel Reduction	(\$ / year)	\$ -	\$ 52,448	\$ 262,240	\$ 472,032	\$ 681,824	\$ 891,616
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 6,675	\$ 33,376	\$ 60,077	\$ 86,778	\$ 113,478
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ -	\$ 3,360	\$ 19,600	\$ 40,320	\$ 65,520
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 316	\$ 1,896	\$ 3,982	\$ 6,573	\$ 9,670
Course Compression	(\$ / year)	\$ -	\$ 44,174	\$ 220,871	\$ 397,567	\$ 574,264	\$ 750,960
Sub-total		\$ -	\$ 103,613	\$ 521,743	\$ 953,257	\$ 1,389,758	\$ 1,831,244
MULTI-MEDIA / CBT							
Air Travel Reduction	(\$ / year)	\$ -	\$ 25,630	\$ 76,890	\$ 128,150	\$ 179,410	\$ 230,670
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 3,262	\$ 9,786	\$ 16,310	\$ 22,834	\$ 29,358
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 10,500	\$ 31,500	\$ 52,500	\$ 73,500	\$ 94,500
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ 790	\$ 2,370	\$ 3,950	\$ 5,530	\$ 7,110
Course Compression	(\$ / year)	\$ -	\$ 131,735	\$ 395,204	\$ 658,673	\$ 922,142	\$ 1,185,612
Sub-total		\$ -	\$ 171,917	\$ 515,750	\$ 859,583	\$ 1,203,416	\$ 1,547,250
INTERNET							
Air Travel Reduction	(\$ / year)	\$ -	\$ 25,234	\$ 75,702	\$ 126,170	\$ 189,255	\$ 264,957
Avoidance of Lost Time	(\$ / year)	\$ -	\$ 3,212	\$ 9,635	\$ 16,058	\$ 24,087	\$ 33,722
Reduction in Instructor Costs	(\$ / year)	\$ -	\$ 10,500	\$ 31,500	\$ 52,500	\$ 78,750	\$ 110,250
Reduction in Instructor Travel Costs	(\$ / year)	\$ -	\$ -	\$ 790	\$ 2,370	\$ 3,950	\$ 5,925
Course Compression	(\$ / year)	\$ -	\$ 129,699	\$ 389,098	\$ 648,496	\$ 972,744	\$ 1,361,842
Sub-total		\$ -	\$ 168,645	\$ 506,724	\$ 845,594	\$ 1,268,786	\$ 1,776,696
Total Recurring Benefit		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-Recurring Costs							
ITV							
Studios	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Uplinks	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Satellite Downlinks	(\$ / year)	\$ -	\$ 80,000	\$ 80,000	\$ 80,000	\$ 80,000	\$ 80,000
Classroom Conversion	(\$ / year)	\$ -	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000
Course Conversion (ITV)	(\$ / year)	\$ -	\$ 188,100	\$ 250,800	\$ 250,800	\$ 233,365	\$ 233,365
Sub-total		\$ -	\$ 328,100	\$ 390,800	\$ 390,800	\$ 373,365	\$ 373,365
MULTI-MEDIA / CBT							
Cost of MM computers (stand alone)	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Training Centers (w / computers)	(\$ / year)	\$ -	\$ 234,000	\$ 234,000	\$ 234,000	\$ 234,000	\$ 234,000
Course Distribution	(\$ / year)	\$ -	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000	\$ 4,000
Course Conversion Costs	(\$ / year)	\$ -	\$ 415,385	\$ 415,385	\$ 415,385	\$ 415,385	\$ 415,385
Sub-total		\$ -	\$ 653,385	\$ 653,385	\$ 653,385	\$ 653,385	\$ 653,385

Table 6-9. Summary of Alternative E Analysis Data (continued)

INTERNET							
Server Acquisition and Installation	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Course Conversion Costs	(\$ / year)	\$ -	\$ 84,600	\$ 84,600	\$ 84,600	\$ 230,677	\$ 230,677
Training Platforms	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Sub-total	\$ -	\$ 84,600	\$ 84,600	\$ 84,600	\$ 230,677	\$ 230,677
Total Non-Recurring Costs		\$ -	\$ 1,066,085	\$ 1,128,785	\$ 1,128,785	\$ 1,257,426	\$ 1,257,426
Recurring Costs							
ITV							
Studio Operations Costs	(\$ / year)	\$ -	\$ 16,712	\$ 83,561	\$ 150,410	\$ 202,155	\$ 264,356
Instructor Preparation	(\$ / year)	\$ -	\$ 2,945	\$ 14,726	\$ 26,507	\$ 35,627	\$ 46,589
Course Update	(\$ / year)	\$ -	\$ 898	\$ 4,488	\$ 8,078	\$ 10,858	\$ 14,198
Satellite Air Time	(\$ / year)	\$ -	\$ 2,255	\$ 11,276	\$ 20,297	\$ 27,280	\$ 35,673
Uplink Service charge	(\$ / year)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Facilitator Cost	(\$ / year)	\$ -	\$ 16,800	\$ 100,800	\$ 211,680	\$ 349,440	\$ 514,080
Downlink service charge	(\$ / year)	\$ -	\$ 36,864	\$ 73,728	\$ 110,592	\$ 147,456	\$ 184,320
Terrestrial Line Usage	(\$ / year)	\$ -	\$ 576	\$ 3,456	\$ 7,258	\$ 11,981	\$ 17,626
	Sub-total	\$ -	\$ 77,050	\$ 292,035	\$ 534,822	\$ 784,796	\$ 1,076,842
MULTI-MEDIA / CBT							
Course Update	(\$ / year)	\$ -	\$ 3,600	\$ 10,800	\$ 18,000	\$ 25,200	\$ 32,400
Training Center computer maintenance	(\$ / year)	\$ -	\$ 3,150	\$ 6,300	\$ 9,450	\$ 12,600	\$ 15,750
Centralized Help Line Support	(\$ / year)	\$ -	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000	\$ 70,000
Site Proctors / Systems Administrators	(\$ / year)	\$ -	\$ 126,000	\$ 252,000	\$ 378,000	\$ 504,000	\$ 630,000
Course Re-distribution	(\$ / year)	\$ -	\$ 1,000	\$ 3,000	\$ 5,000	\$ 14,000	\$ 18,000
	Sub-total	\$ -	\$ 203,750	\$ 342,100	\$ 480,450	\$ 625,800	\$ 766,150
INTERNET							
Course Update	(\$ / year)	\$ -	\$ 1,200	\$ 3,600	\$ 6,000	\$ 18,000	\$ 25,200
	Sub-total	\$ -	\$ 1,200	\$ 3,600	\$ 6,000	\$ 18,000	\$ 25,200
Total Recurring Costs		\$ -	\$ 282,000	\$ 637,735	\$ 1,021,272	\$ 1,428,596	\$ 1,868,192
ANALYSIS OF BENEFITS AND COSTS							
Non-recurring Benefits		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Recurring Benefits		\$ -	\$ 444,175	\$ 1,544,217	\$ 2,658,435	\$ 3,861,960	\$ 5,155,189
Non-recurring Costs		\$ -	\$ (1,066,085)	\$ (1,128,785)	\$ (1,128,785)	\$ (1,257,426)	\$ (1,257,426)
Recurring Costs		\$ -	\$ (282,000)	\$ (637,735)	\$ (1,021,272)	\$ (1,428,596)	\$ (1,868,192)
	Net Result	\$ -	\$ (903,910)	\$ (222,303)	\$ 508,378	\$ 1,175,939	\$ 2,029,571
OMB Discount Rate		3.1%					
Net Present Value		\$ 2,096,051					
Return on Investment		46%					
Benefit/ Cost Ratio		1.22					

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